

## SECTION 123

### REINFORCED CONCRETE PIPE

#### 123.1 GENERAL

123.1.1 These specifications cover reinforced concrete pipe intended to be used for the construction of storm drains, sewers, and related structures.

123.1.2 The size and class of the concrete pipe to be furnished shall be as shown on the plans or as specified under the item of work for the project of which the pipe is a part.

123.1.3 Unless otherwise specified, pipe shall be either cast, spun, or manufactured by an approved equal method.

123.1.4 The interior surface shall be smooth and well finished. Joints shall be of such type and design and so constructed as to be adequate for the purpose intended so that, when laid, the pipe will form a continuous conduit with smooth and uniform interior surface.

123.1.5 Bell and spigot shall be free from any deleterious substance or condition which might prevent a satisfactory seal at the joints.

123.1.6 Pipe stronger than that specified may be furnished at the manufacturer's option and at his own expense, provided such pipe conforms in all other respects to the applicable provisions of these specifications.

123.1.7 Reinforced concrete pipe utilized for sanitary sewers shall be fully lined with no longitudinal seams in accordance with Section 122.

#### 123.2 REFERENCES

123.2.1 American Society for Testing and Materials (Latest Editions)(ASTM)

- C-33 Specification for Concrete Aggregates
- C-76 Specification for Reinforced Concrete Culverts, Storm Drain, and Sewer Pipe
- C-150 Specification for Portland Cement
- C-260 Specification for Air Entraining Admixtures for Concrete
- C-361 Specification for Reinforced Concrete Low-Head Pressure Pipe
- C-441 Test Method for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali Aggregates Reaction
- C-443 Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gasket
- C-494 Specification for Chemical Admixtures for Concrete
- C-618 Specification for Fly Ash and Raw of Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

123.2 American Concrete Pipe Association (ACPA)

Concrete Pipe Design Manual

123.2.3 This Publication  
Section 102 Steel Reinforcement  
Section 122 Plastic Liner Plate

#### 123.3 PIPE LINE LAYOUTS

123.3.1 When specials and radius pipe and/or fittings are required, the required number of sets of the pipe line layout will be furnished to the ENGINEER prior to the manufacture of the concrete pipe. Storm inlet or inlet connector pipe need not be included in the pipe line layout; however, pipe stubs shall be included. In lieu of including storm inlet connector pipe line layout, a list of storm inlet connector pipes shall accompany the layout. The connector pipe list shall contain the following information:

123.3.1.1 Size, class, and wall type.

123.3.1.2 Station at which pipe joins main line.

123.3.1.3 Number of sections of pipe, length or section, type of sections (straight, horizontal bevel, vertical bevel, etc.).

#### 123.4 MATERIALS

123.4.1 Reinforced Concrete Pipe shall consist of a mixture of Portland cement, aggregates, water and admixtures, proportioned and manufactured in accordance with the requirements of ASTM C76, latest edition, and this specification. The pipe shall be certified in accordance with the requirements of Section 13 of these specifications. Certification of compliance shall be submitted by the CONTRACTOR and approved by the ENGINEER prior to manufacture of the Reinforced Concrete Pipe, Reinforced Concrete Pipe shall not be used on a project without written approval of the ENGINEER.

123.4.2 Portland cement shall comply either with the requirements of ASTM C 150, Types I, II, III, and V, Low Alkali (LA) cements, or as specified herein, in the Supplementary Technical Specifications, plans, or as approved by the ENGINEER. The CONTRACTOR shall submit certification of compliance signed by the cement manufacturer, identifying the cement type and source (plant location), stating the portland cement used in the Reinforced Concrete Pipe delivered to the project complies with this specification. Portland cement concrete used in the manufacture of Reinforced Concrete Pipe shall have a minimum portland cement content of 470 lbs./cu.yd., except as either specified

herein, as specified in the Supplemental Technical Specifications, or as approved by the ENGINEER. Portland cement shall be of the same source and type for all Reinforced Concrete Pipe delivered to a project.

123.4.2.1 Portland cement concrete for Reinforced Concrete Pipe shall be proportioned to provide a minimum portland cement content of 470 lbs./c.y. (5 sks/c.y.) and a maximum water (W) to cementitious material ratio by weight,  $W:(C+TA)=0.40$ . Cementitious material shall consist of portland cement and class F fly ash complying with this specification. The fly ash shall be proportioned to provide a fly ash (FA) to portland cement (C) ratio by weight, FA:C+I:r.

123.4.3 Mineral admixtures shall be "Class F fly ash" and comply with the requirements of ASTM C 618 including Table 4 "Supplementary Optional Physical Requirements."

- A. Uniformity requirements, air entraining agent dosage for 18.0% vol of mortar, shall not vary by more than 20%
- B. Reactivity with cement alkalis: Reduction of mortar bar expansion at 14 days, minimum (ASTM C441) 65%

Reactivity with cement alkalis shall be determined in accordance with the requirements of ASTM C441, using DOW CORNING glass rod base for aggregates. The CONTRACTOR shall submit certification of compliance identifying the type fly ash and source (plant location), stating the fly ash used in the Reinforced Concrete Pipe delivered to the project complies with this specification. Fly ash shall be of the same source and type for all Reinforced Concrete Pipe delivered to the project.

123.4.4 Admixtures of any type, shall not be used without written approval of the ENGINEER. The CONTRACTOR shall submit certification of compliance signed by the admixture manufacturer, identifying the admixture and its source (plant location), stating the admixture(s) used complies with this specification. Admixtures shall be of the same source for all reinforced concrete Pipe delivered to a project.

123.4.4.1 Air entraining admixtures shall be used in all Reinforced Concrete Pipe provided under this specification. It shall conform to the requirements of ASTM C 260. Entrained air content shall comply with the following requirements:

Nominal Max Size Aggregate (inches)	Air Cont. Range (%)
3/8, 1/2 & 3/4	4 - 8
1	4 - 7
1-1/2	3 - 6

or as required by the Supplementary

Technical Specifications, on the plans and/or as approved by the ENGINEER.

123.4.4.2 Chemical admixtures shall conform to either the requirements of ASTM C 494, and/or as specified in the Supplementary Technical Specifications, on the plans, and/or as approved by the ENGINEER.

123.4.4.3 Neither calcium chloride nor non-calcium chloride accelerating admixtures shall be used in Reinforced Concrete Pipe provided to a project under this specification.

123.4.4 Aggregates shall be assumed to be alkali-reactive. Variance for a specific aggregate may be approved by the Engineer upon written request by the CONTRACTOR and submittal of test data, as required by the ENGINEER. Aggregates shall comply with the requirements of ASTM C 33 and ASTM C 76 and as specified herein. Aggregates shall be of the same source and type for all Reinforced Concrete Pipe manufactured and delivered to the project.

123.4.5 Reinforcement shall comply with the requirements of this specification and Section 102. The CONTRACTOR shall submit certification of compliance signed by the reinforcement manufacturer, identifying the material and its source (plant location), stating the reinforcement complies with this specification. Reinforcement shall be of the same source for all Reinforced Concrete Pipe delivered to the project.

#### 123.5 CAUSES FOR REJECTION

Such inspection of pipe as may be deemed necessary by the ENGINEER will be made at the place of manufacture and pipe may be rejected for any of the reasons described in ASTM C 76, unless it can be repaired in accordance with the requirements noted therein and the approval of the ENGINEER.

#### 123.6 ACCEPTANCE

Basis of acceptance shall be in compliance with ASTM C 76.

##### 123.6.1 D-LOAD BEARING STRENGTH METHOD

123.6.1.1 The ENGINEER will select at random at the point of manufacture test specimens of the pipe to be furnished for the project.

123.6.1.2 The required number of test specimens and the test pipe shall conform in all respects to the applicable requirements of ASTM C 76. The pipe shall be tested by one of the two standard methods of testing; namely, (A) the three-edge bearing, (B) the sand bearing, as prescribed in ASTM C 76, and the required strength of the pipe specimens undergoing the bearing tests shall conform with the D-Load requirements designated therein.

## 123.6.2 STRUCTURAL DESIGN METHOD:

Where structural details of the pipe are shown on the plans, the manufacture of pipe shall be checked by making the appropriate tests on the concrete placed in the pipe forms, by inspection of the steel reinforcing cages that are to be used in the pipe, and by inspection of the fabrication of the pipe.

## 123.6.3 "DOWNGRADING" OF PIPE:

123.6.3.1 For the purpose of these specifications, "downgraded" pipe shall be defined as pipe which is to be used under loads less than that for which they have been designed.

123.6.3.2 Pipe manufactured in accordance with these specifications which have not met their designed test loads may be "downgraded" by the ENGINEER and used provided that:

123.6.3.2.1 Enough load tests are made to establish the load under which they may be used. The number of tests to be made shall be as determined by the ENGINEER; this may require the testing of each section for acceptance.

123.6.3.2.2 The comply with the test and inspection requirements of these specifications.

123.6.3.3 Individual specimens of pipe embodying major repairs or having numerous hairline cracks extending the full length of the section on the inside of the pipe at the minor axis or on the outside of the pipe at the major axis may be tested for acceptance at the discretion of the ENGINEER.

## 123.6.4 STOCKPILED PIPE:

123.6.4.1 Stockpiled pipe may be used only when approved by the ENGINEER provided the pipe meets all other specified requirements.

123.6.4.2 For the purpose of these specifications, "stockpiled" pipe shall be defined as pipe manufactured in quantity which will meet requirements of this section but which was not manufactured for use in specific projects; however, pipe which has been rejected by another agency will not be considered as "stockpiled" pipe, nor will such pipe be accepted.

## 123.7 JOINTS

123.7.1 For circular pipe, rubber gasket joints shall be required. Such joints shall conform to the requirements of ASTM C 443 and the requirements set forth in this document. The joint shall be designed for not less than 15%, or more than 50% deformation of the rubber gasket when the pipe is joined off-center with all manufacturing tolerances considered. Minimum manufacturing tolerances shall be

assumed to result in a centered annular space of 1.75 times the nominal design annular space. Joint mating surfaces shall be parallel and not be greater than 3.5° slopes. In addition to the hydrostatic joint test requirements per ASTM C 443, the pipe shall be loaded to cause maximum joint annular space to occur at the top. The pipe shall then be subjected to an internal hydrostatic pressure of 13 psi for 10 minutes. The test set up shall include a minimum of (2) pipe sections per lot. Bulkheaded end joints are acceptable, only mating pipe joints are allowed. Moisture or beads of water appearing on the surface of the joint will not be considered as leakage. If leakage of joints should initially occur, the manufacturer shall have the option to allow the pipe to soak under pressure for up to 24 hours and then retest. Any leakage during such retest will constitute failure of the test.

Pipe with beveled ends or pipe joints specifically designed to allow unsymmetrical joint closure may be provided for use around curves, the radii of which are shown on the drawings. Unless otherwise shown on the plans or specified in the Supplementary Specifications, either one or both ends may be beveled up to a maximum of 5 degrees, as required to provide well fitted joints. Beveled ends may conform to the Typical Method of Designing Curved Concrete Pipe sewers, as shown in the ACPA Concrete Pipe Handbook. Deflections per joint shall be limited to the manufacturer's standards for each particular diameter and type of pipe used.

123.7.2 For elliptical or arch reinforced concrete pipe, the joints shall be either bell and spigot or tongue and groove. Mastic material, such as RAMNEK, KENT SEAL, or approved equal, will be used to seal the joints.

123.7.3 Cement mortar joint fillers will not be accepted for round, elliptical, or arch reinforced concrete pipe.

123.7.4 If required by the ENGINEER to meet specified laying tolerances, the pipe shall be "match marked" at the place of manufacture, and laying diagrams furnished to the CONTRACTOR by the manufacturer shall be subject to approval by the ENGINEER.

## 123.8 DIMENSIONS

### 123.8.1 LENGTH

123.8.1.1 The nominal length shall be as supplied by the manufacturer unless otherwise specified in the Supplementary Technical Specifications on the plans or required for bends or special joints.

123.8.1.2 Except for special shapes, the plane of the ends of the pipe shall be perpendicular to the longitudinal axis of the pipe, with the exception that variations in laying lengths of two

opposite sides of pipe shall be not more than 1/8 inch per foot of diameter with a maximum of 5/8 inch in any length of pipe.

#### 123.8.2 WALL THICKNESS

The wall thickness of pipe shall conform to the requirements indicated for Wall B or Wall C, reinforced concrete pipe specified in ASTM C 76 unless otherwise specified.

#### 123.9 REINFORCEMENT

Fabrication and placement of reinforcement for the various sizes and strengths of pipe shall conform to the applicable requirements of ASTM C 76.

#### 123.10 CURING REQUIREMENTS

The pipe shall be cured in conformance with the applicable requirements of ASTM C 76.

#### 123.11 MARKINGS:

123.11.1 Each section of pipe shall be marked in conformance with the requirements of ASTM C 76. The ENGINEER may at the place of manufacture, indicate his acceptance of the pipe for delivery to the job by marking the pipe with the Contracting Agency's mark. Such acceptance, however, shall not be considered a final acceptance.

123.11.2 If the pipe is subsequently rejected, the mark placed thereon by the ENGINEER shall be defaced. No pipe will be marked, "Reject." Only pipe accepted shall be marked, "Accepted."

#### 123.12 LOW-HEAD PRESSURE PIPE

Reinforced concrete low-head pressure pipe shall conform to the requirements of ASTM C 361.

#### 123.13 SELECTION FOR CLASS OF PIPE

123.13.1 The classes of reinforced concrete pipe and the D-Load to produce a 0.01-in. crack for each class of pipe are specified in ASTM C 76.

123.13.2 The appropriate formulas, tables and figures contained in the "Concrete Pipe Design Manual," prepared by the American Concrete Pipe Association, will be used, to determine the class of pipe to be installed between manholes or for a culvert. It is essential that maximum trench width, class of bedding and soil weight be considered in the pipe class selection.

123.13.3 The construction plans will indicate the following information for each length of pipe between manholes or for a culvert: the nominal diameter of the pipe, the class of pipe, the class of bedding and the maximum trench width at top of pipe.

#### 123.14 MEASUREMENT AND PAYMENT

123.14.1 The measurement and payment for the materials specified in this section will be made as specified in the applicable section of these specifications or as specified in the supplemental technical specifications or as called for in the plans and as shown in the Bid Proposal.